Energetic Particle Contributions to A Magnetospheric Constellation Mission

G D Reeves, R D Belian, T E Cayton, R H W Friedel, M G Henderson, D N Baker, and H E Spence

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Why Energetic Particles?

- Great Physics
- Unique Properties
- New Instruments
- Data Synthesis
- Space Weather Applications
- Practical Considerations

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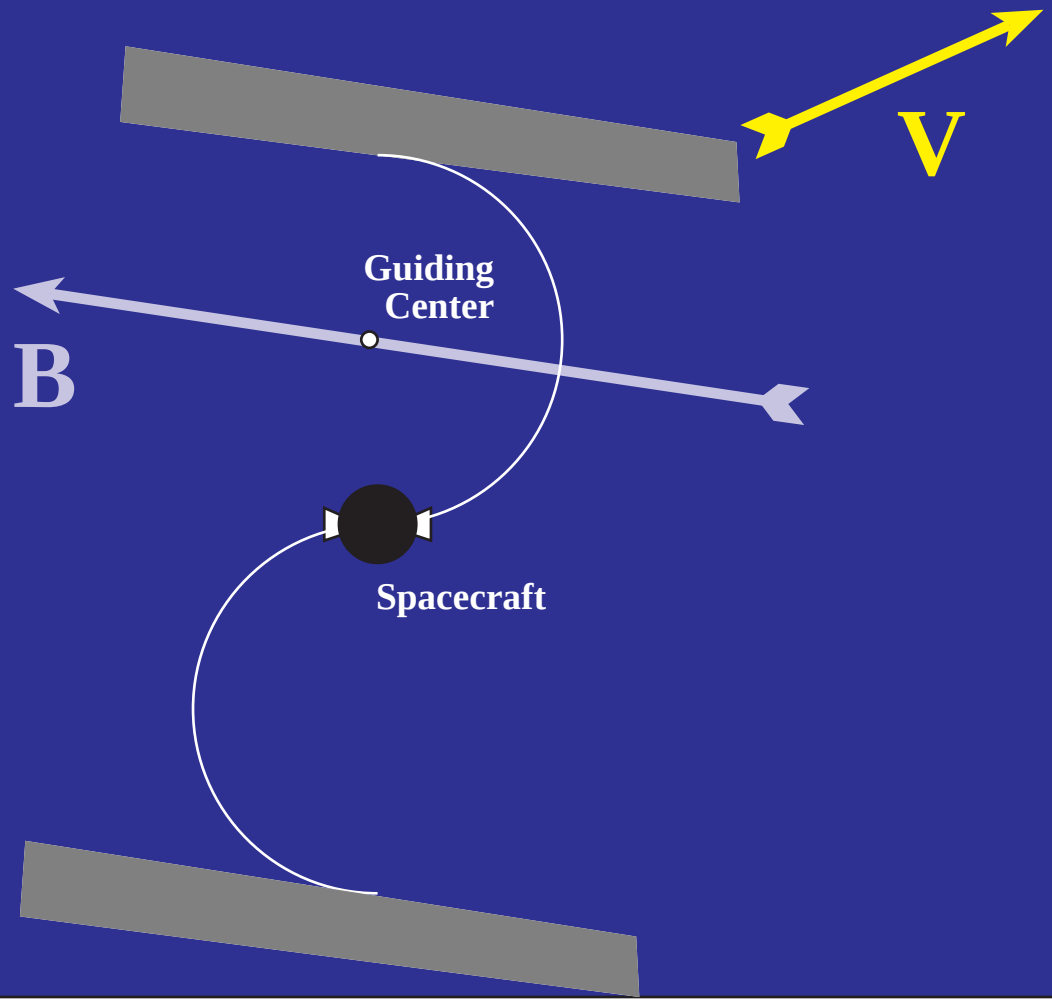
Great Physics...

- They are the bulk of important populations
  - Radiation Belts: **structure & dynamics, precipitation, electrodynamics, climate**
  - Ring Current: **buildup, decay, asymmetry, source for ENAs, etc.**
  - Substorm Injections: **relationship to flow bursts, aurora, current wedge, etc.**
- They are the signature of energetic processes
  - Storms: **global reconfiguration, energization & injection, precipitation, etc.**
  - Substorms: **storm-substorm relationship, energy storage & release**
  - Relativistic Electron Events: **source, acceleration processes, losses**

Unique Properties

- Gyro-Sounding of Boundaries & Gradients



Unique Properties

Large Scale-Size & Rapid Drift

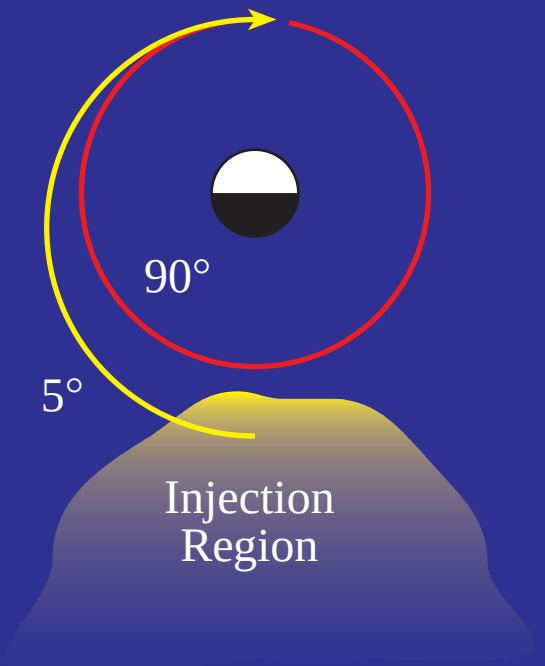
- Rapid drifts mean that particles sample global electric and magnetic fields

- Energy-dependent sensitivity of drift paths to electric fields e.g. trapping boundaries

- Large-scale coherence of populations - e.g. drift echoes

- Drift shell splitting for different pitch angles

Takahashi et al., 1997



New Instruments

- ‘This is not your father’s solid state detector’

  - Less is More:

    Lower Power, Weight, Size & **Cost**

  - Interchangeable Instruments:

    e.g. GPS - X-ray/Dosimeter/Combined

  - New Technologies:

    e.g. Cad-Zinc-Telluride, Detector Arrays

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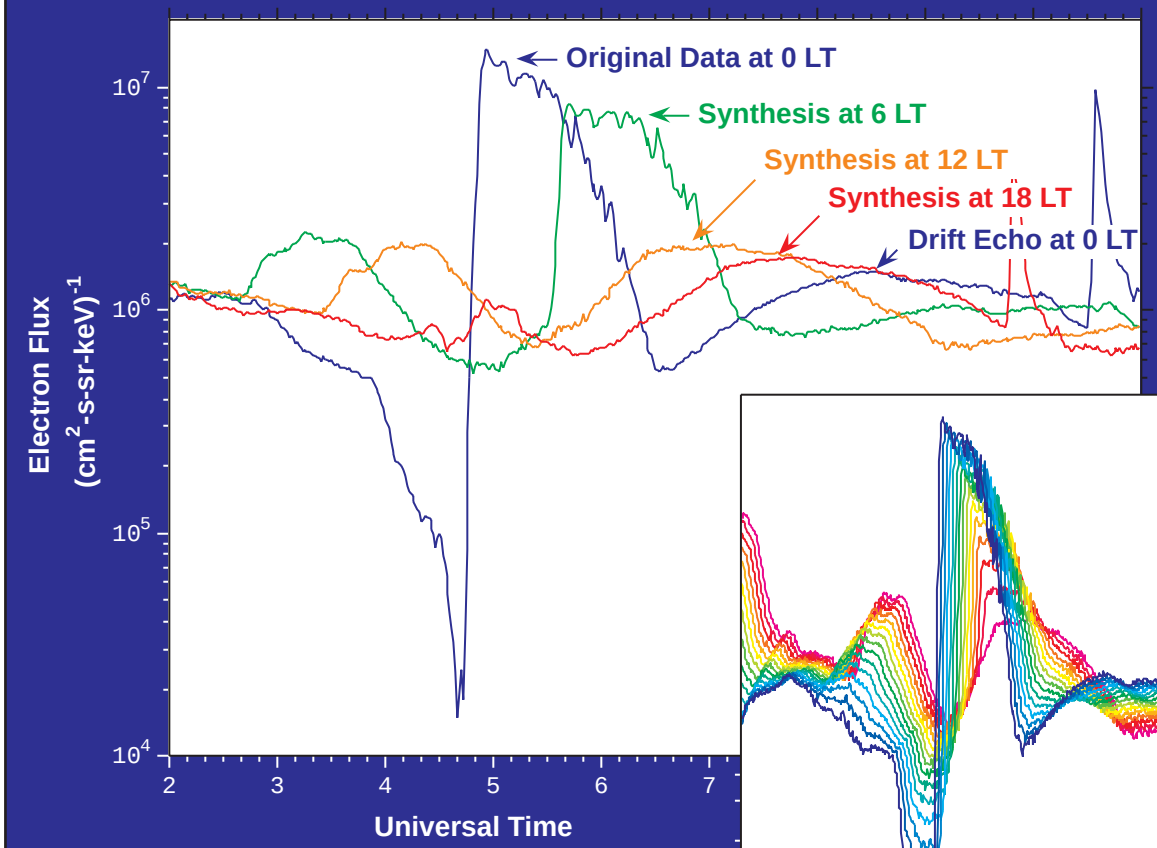
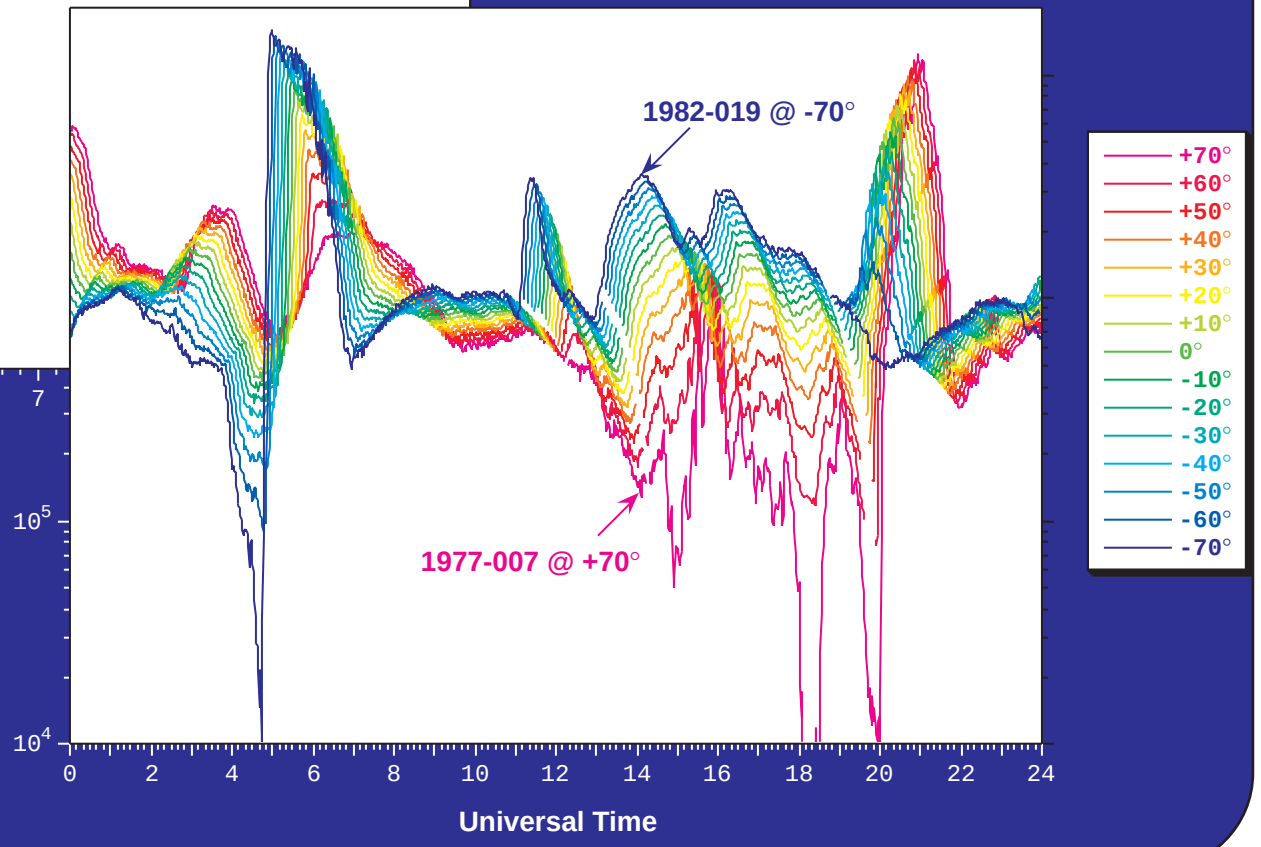
Data Synthesis



- Global Coherence
- Fast Drift Speeds
- Few Satellites Needed
- Minimal Modelling



Space Weather Applications

Direct practical benefits

- Spacecraft Effects: **surface charging, bulk charging, single-event upsets**
- Data Synthesis: **fluxes, fluences & dose at any longitude, local time or orbit**
- Education: **basic physics of particles and fields, easily understood 'pictures'**

Multi-use will still be important

- Multi-agency support: **must benefit commercial, military, & scientific**
- Use existing platforms: **complement data from GOES, GPS, etc.**

Practical Considerations

Orbits

Lower altitude orbits are lower cost. Constellation may start as an inner magnetospheric mission

Telemetry

Energetic Particle instruments need relatively low bit rates and little on-board processing

Flexability

Each spacecraft must be simple but it may not be necessary, or desirable, to fly the same instruments on all satellites.

Continuous Success

Energetic Particle measurements can produce measurable successes early – before the full Constellation is deployed